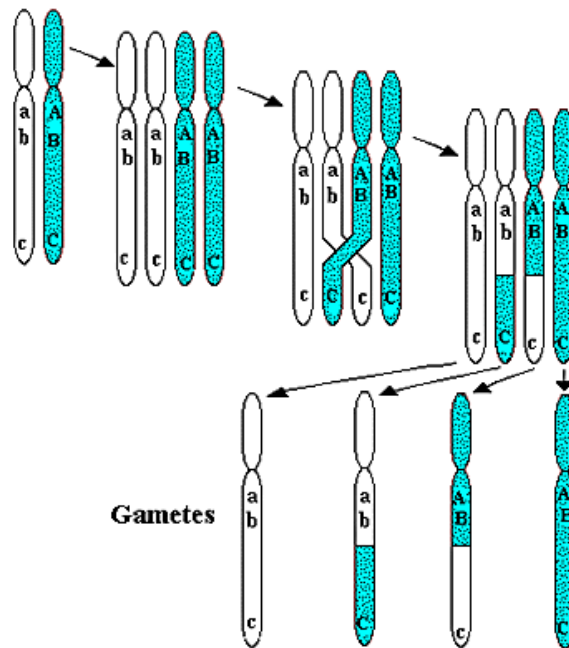


### ***Crossing Over***

**Chromosomal crossover** (or **crossing over**) is the exchange of genetic material between homologous chromosomes during prophase 1 of meiosis. This often occurs during [prophase 1](#) of [meiosis](#) in a process called [synapsis](#). Synapsis begins before the [synaptonemal complex](#) develops, and is not completed until near the end of prophase 1. Crossover usually occurs when matching regions on matching [chromosomes](#) break and then reconnect to the other chromosome. The result of this process is an exchange of [genes](#), called [genetic recombination](#). Chromosomal crossovers also occur in asexual organisms and in [somatic cells](#), since they are important in some forms of [DNA repair](#).



**Crossing-over and recombination during meiosis**

### ***Genetic recombination***

**Genetic recombination** is the process by which a strand of genetic material (usually [DNA](#); but can also be [RNA](#)) is broken and then joined to a different DNA molecule. In [eukaryotes](#) recombination occurs in mitosis as a common mechanism of DNA repair and in [meiosis](#) as a way of facilitating [chromosomal crossover](#). The crossover process leads to offspring having different combinations of genes from their parents, and can occasionally produce new chimeric [alleles](#). In evolutionary biology this shuffling of genes is thought to have many advantages, as it is a major engine of [genetic variation](#) and also allows asexually reproducing organisms to avoid [Muller's ratchet](#). In [molecular biology](#) "recombination" can also refer to artificial and deliberate recombination of disparate pieces of DNA, often from different organisms, creating what is called [recombinant DNA](#). [Enzymes](#) called [recombinases](#) catalyze natural recombination reactions. [RecA](#), the chief recombinase found in [E. coli](#), is responsible for the repair of DNA double strand breaks (DSBs). In yeast and other eukaryotic organisms there are two recombinases required for repairing DSBs. The [RAD51](#) protein is required for [mitotic](#) and [meiotic](#) recombination and the [DMC1](#) protein is specific to meiotic recombination.